with partial differential equations. The governing equations are developed in the context of a physical model and both analytical and numerical methods to solve the problem are explained.

The first two chapters serve as introductory material for the subject treated in the book. In Chapter 1 the different difference approximations for derivatives are introduced. The important concepts in finite difference methods, such as error analysis and stability are treated well. Efforts have been made to distinguish between implicit and explicit methods in solving problems. In Chapter 2 the author discusses methods of solution for the first order partial differential equations. The method of characteristics is introduced and the applications of difference methods are reviewed.

Chapter 3 forms a major part of the book, gives a thorough treatment to the development of second order hyperbolic partial differential equations and various analytical methods for solving them. The concepts of domains of influence and dependence are explained well. The author has also dealt with conservation laws and propagation of discontinuities in the context of the wave equation. The latter part of this chapter contains several examples dealing with the application of difference methods in solving both linear and nonlinear wave propagation problems. In Chapter 4 parabolic equations have received only a cursory treatment in comparison to the hyperbolic system in the previous chapter. In the context of heat conduction both implicit and explicit difference methods for solving the problems are illustrated. Stability analysis has been carried out for the difference schemes discussed in Chapters 3 and 4. Chapter 5 deals with analytical treatment of the governing equations in fluid dynamics. Though the subject has been dealt with in some detail, it does not contain any description of difference methods for dealing with shocks or other fluid dynamics problems. The exercises at the end of the chapters places emphasis on analytical methods.

The inclusion of a list of references for further study would have been useful to motivated readers to further their knowledge in this field. A nice feature of this book is that it gives a good blend of analytical and numerical methods for solving problems. This book could serve as an introductory text to students in engineering sciences and as a guide to practicing engineers to acquaint them with difference methods for solving transient problems.

Numerical Methods in Engineering and Science, by G. de Vahl Davis. Allen and Unwin, Inc., Winchester, MA, 1986. 286 pages. Price: cloth/$34.95; paper/$19.95.

REVIEWED BY P. D. RICHARDSON[5]

Professor de Vahl Davis has published extensively on convective transport using computational methods. In this book, based on roughly twenty-five years' experience in research and teaching, he presents numerical methods for students of engineering and science in an introductory course. His approach is to teach the *application* of numerical methods to the solution of equations (algebraic, transcendental, and differential) which are encountered frequently. The methods are taught as tools, and theoretical foundations for the methods are not covered rigorously (but references are given).

The teaching of the methods as *tools* shows itself in two ways in particular. The book is full of useful hints on tricks to use and traps to avoid. And Professor de Vahl Davis repeatedly asks the reader to become convinced on various points by *trying* various techniques. He gives emphasis to the point that students will understand numerical methods only once they have used them. The range of understanding here includes not only the principles by which algorithms lead to solution of equations, but also the convergence and stability of the methods and the predictability of the relation of order of error to step size. He encourages efficient style in programming and expects it to develop through self-critical practice.

The eight chapters consist of an introduction, solution of single equations, simultaneous equations (with the switch from direct to iterative methods being discussed in terms of numbers of arithmetic operations involved, and with special treatment of tridiagonal and pentadiagonal systems), interpolation, differentiation and integration, ordinary differential equations (with fine discussion of primitive methods, predictor-corrector, and Runga-Kutta-Merson approaches), partial differential equations (a chapter each for elliptic and parabolic equations) and finally an introduction to integral methods for solution of boundary value problems (weighted residuals, finite elements and boundary elements). de Vahl Davis includes a few useful aids from previous generations of numerical analysts, such as Bickley's difference tables for their pedagogical value (which evoked personal memories from my student days of seeing Professor Bickley's remarkable performance of writing out such tables on a large blackboard when he was alread blind), and Richardson's extrapolation (still a tool for computational economy in some circumstances).

Many of the problems can be worked out by students using small programmable pocket calculators. Some problems require use of a desk-top computer or terminal. The book contains some flowcharts and several Fortran listings (stripped of I/O details that usually vary from place to place). The book can be used in a course of 40-45 lecture hours; the author recommends spreading this over an academic year if possible, to give students time to assimilate ideas and to gain practice through the many exercises given. Upper level engineering undergraduates would be obvious targets for such a course. Because of the breath of useful information given here, the book is likely to be very useful also to professionals who use numerical methods occasionally.

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